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(54) Abstract Title
Alarm apparatus for determining if a vehicle is moved

(57) Alarm apparatus (1) for determining if a vehicle is moved while the alarm apparatus (1) is armed. The alarm apparatus (1) comprises a global position sensing circuit (12) which operates under the control of a control circuit (6). The control circuit (6) reads the current position of the vehicle from the global position sensing circuit (12) at ten minute intervals to check if the vehicle has been moved. Each current position is compared with the first position of the vehicle after the alarm apparatus (1) has been armed, and the difference between the current and first positions is determined. If this difference exceeds a predetermined difference the control circuit (6) activates an interface circuit (14) for powering up a mobile telephone (15). On establishing a telephone line with a central monitoring station, a signal is outputted by the control circuit (6) to the central monitoring station indicating that the vehicle has been moved and the current position of the vehicle.

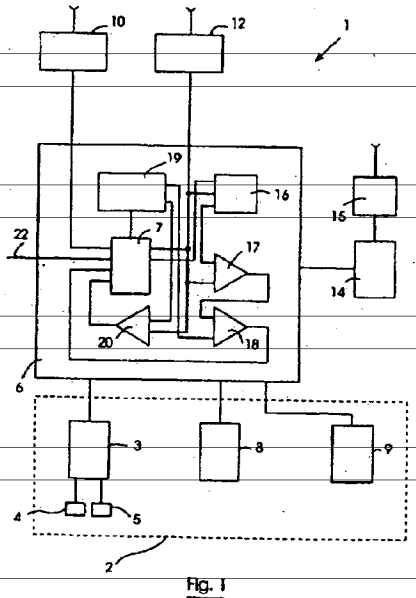

Fig. 1

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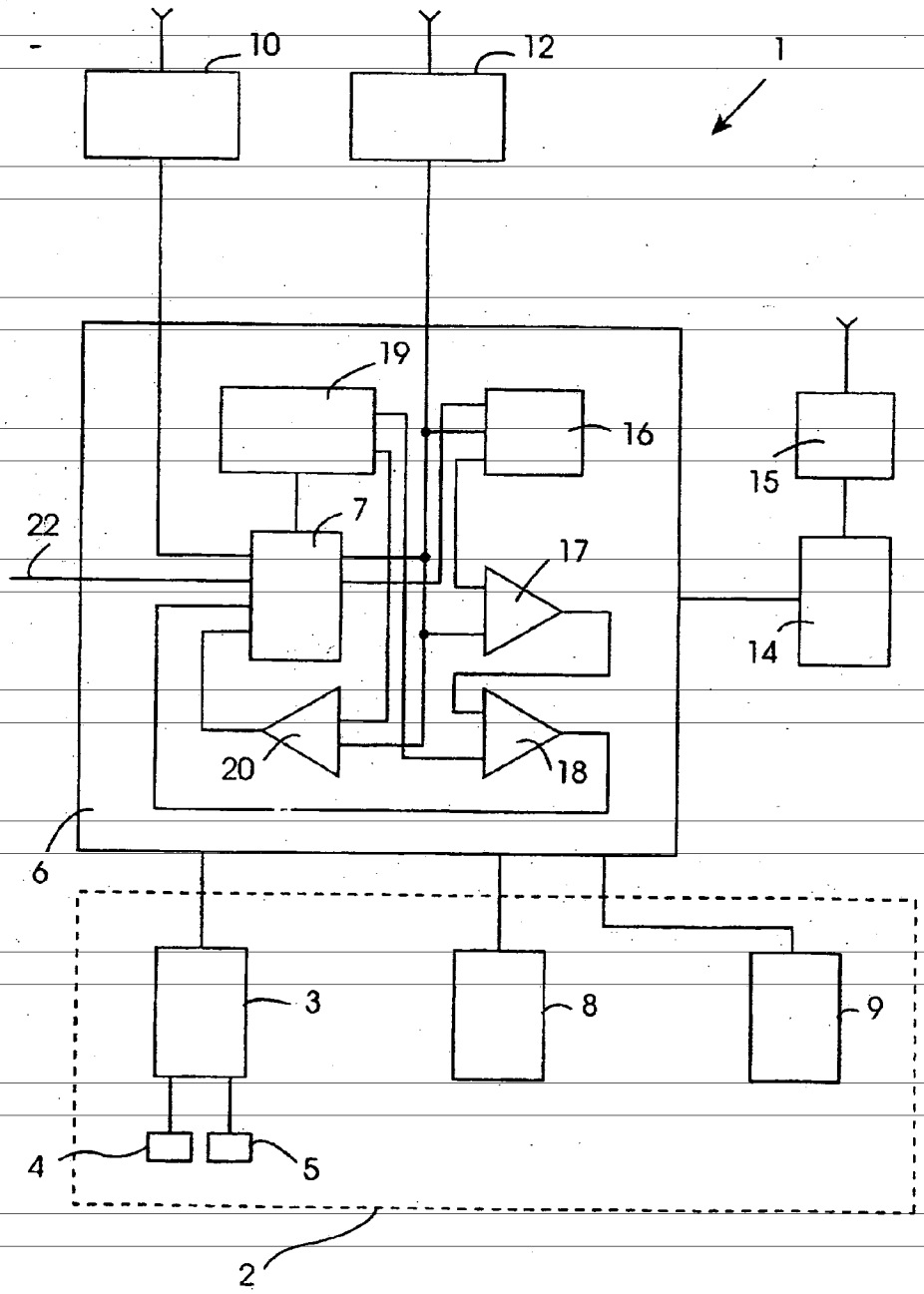

Fig. 1

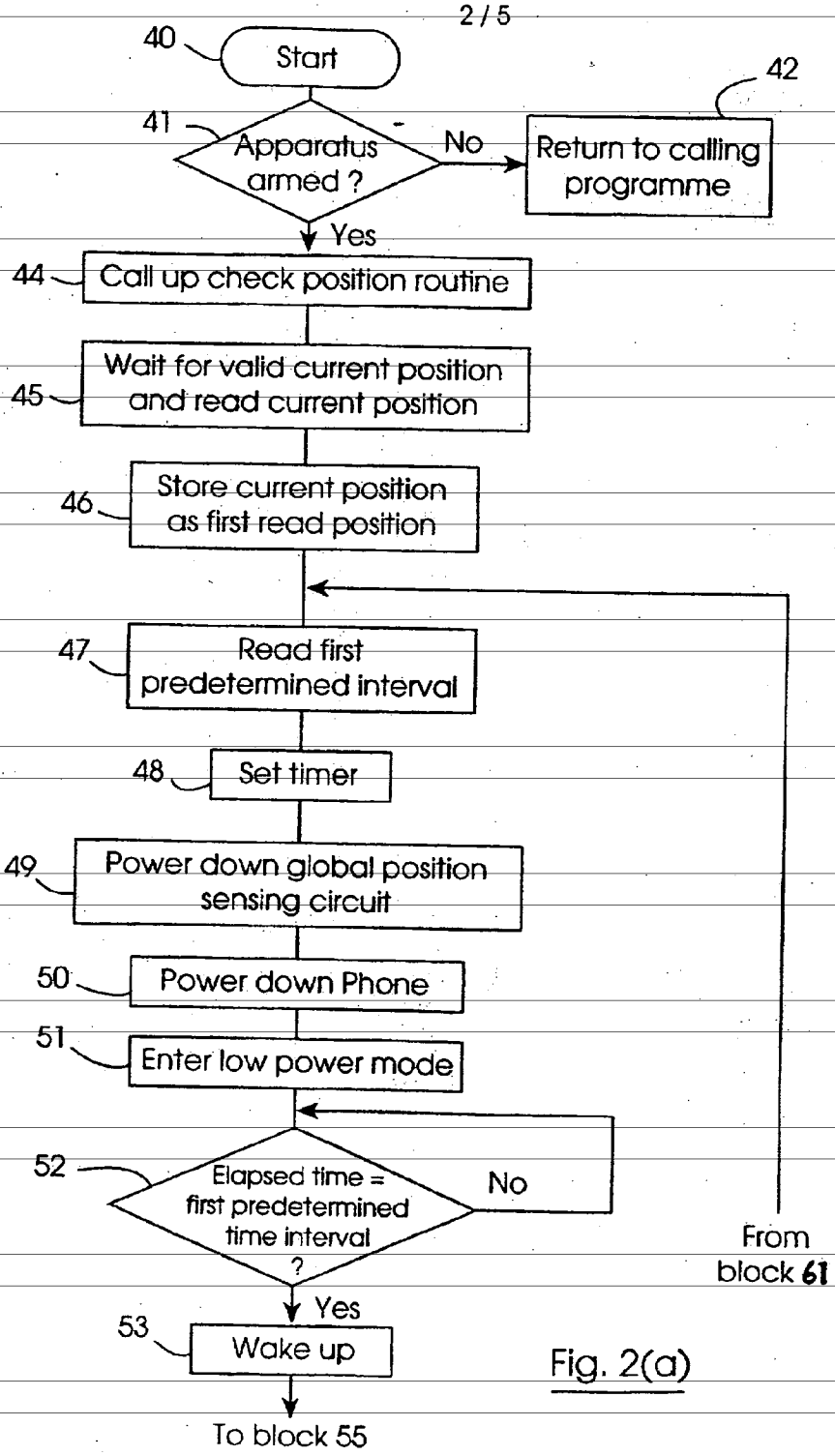

Fig. 2(a)

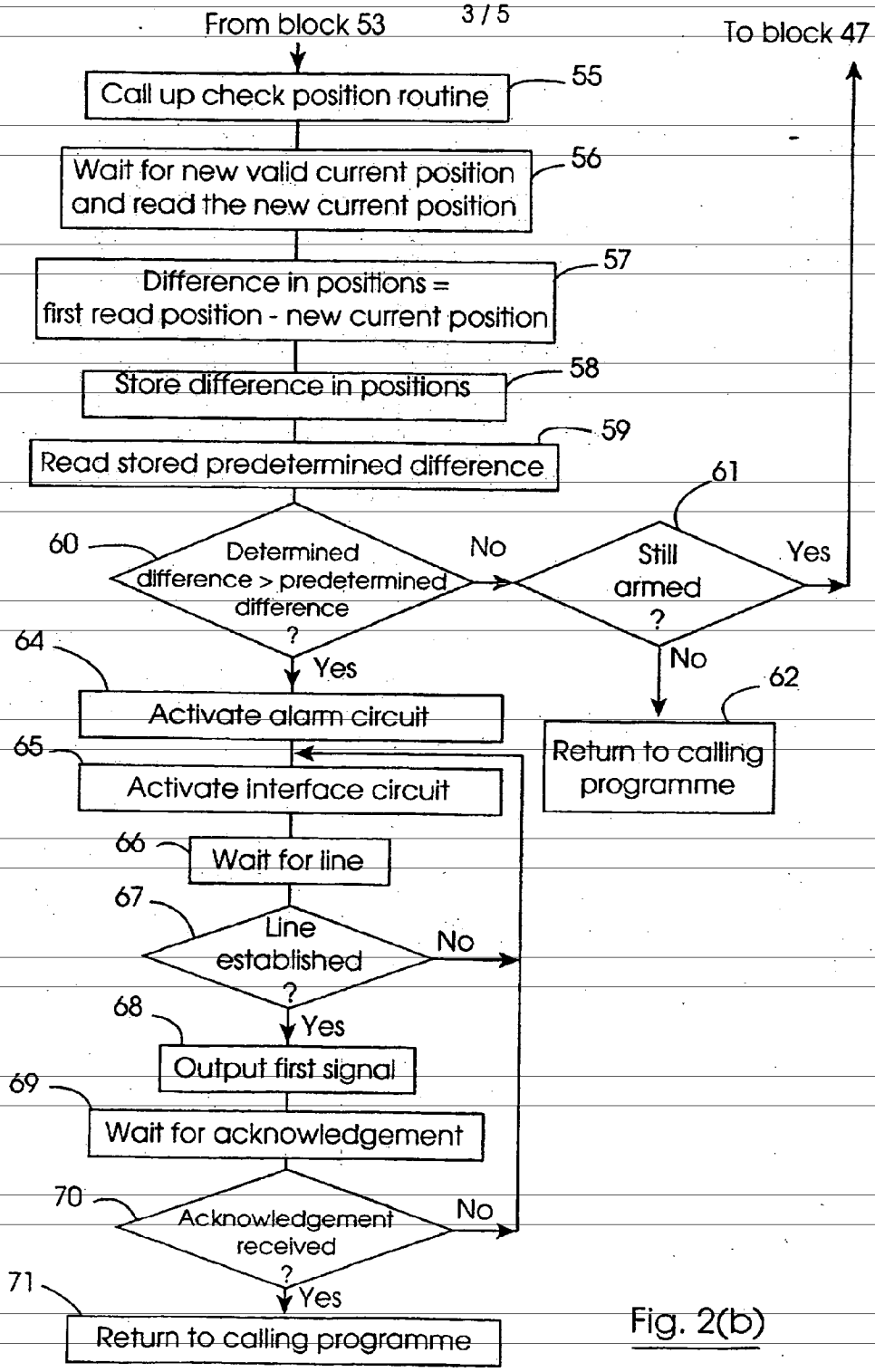

Fig. 2(b)

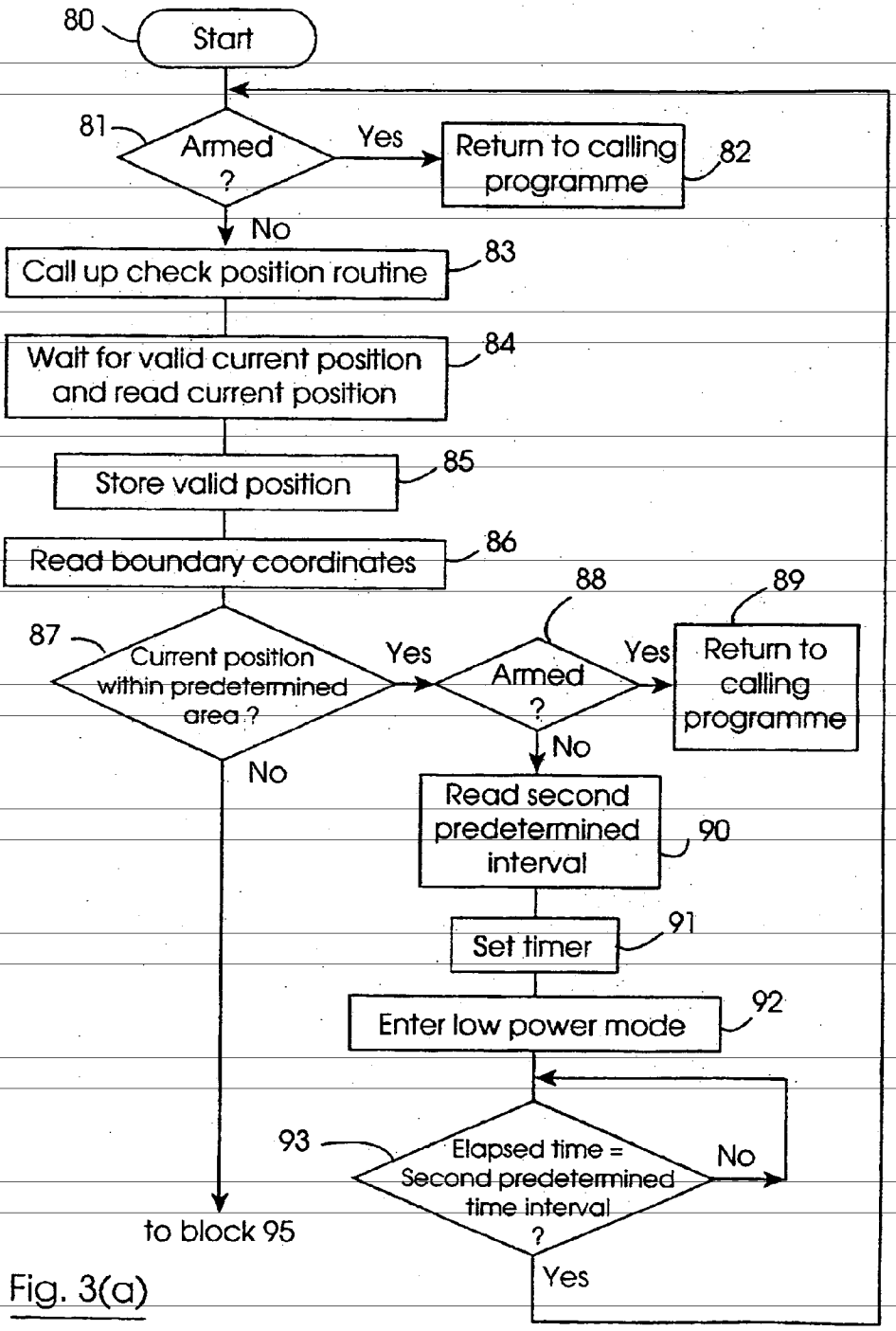

Fig. 3(a)

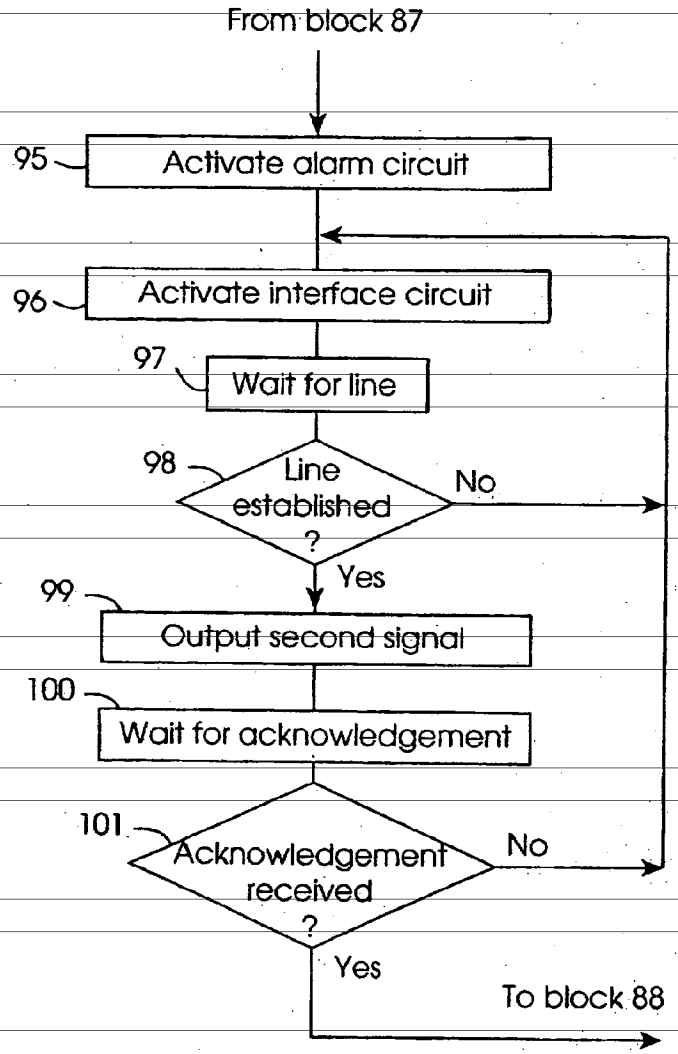
From block 87
95
Activate alarm circuit
96
Activate interface circuit
97
Wait for line
98
Line established ?
No
Yes
99
Output second signal
100
Wait for acknowledgement
101
Acknowledgement received ?
No
Yes
To block 88

Fig. 3(b)

"Alarm apparatus for determining if a vehicle is moved"

The present invention relates to alarm apparatus for a vehicle for determining if the vehicle is moved, and the invention also relates to a method for determining if a vehicle is moved.

Vehicle alarms and immobilisers are well know. Such alarms, in general, are referred to as car alarms, and typically, comprise a monitoring circuit, for monitoring, for example, ultrasonic transducers located within the vehicle for determining unauthorised access to the vehicle. Such alarms also, in general, comprise a vehicle immobilising circuit for immobilising the vehicle, and an alarm circuit for powering an audible alarm in the event of an unauthorised entry to the vehicle. Such car alarms are typically armed and disarmed by a remote transmitter, which typically, is provided in the form of a key fob. While such alarms are adequate for protecting a vehicle parked in, for example, a built-up area where if an unauthorised attempt to enter or take the vehicle is made, the sounding of the alarm, in general, is heard by people in the near vicinity, which in general, is sufficient for causing a thief to take fright and run from the scene, thereby leaving the vehicle. However, such car

alarms are in general, of little value, when a vehicle is parked in a remote unpopulated area, since the alarm, in general, will not be heard, and thus, the thief will be allowed sufficient time to bypass the car alarm, by as is generally referred to "hot wiring" the car or vehicle. Additionally, even when a car is parked in a populated area, it is possible for a thief to move the car, either by pushing the car away from the populated area, or indeed, transferring the vehicle onto a truck or the like, and transporting the car to a location where the car can be "hot wired" in a location convenient for the thief to operate.

It is also desirable that car alarms should draw minimum power from the vehicle battery during armed periods in order to avoid any danger of the vehicle battery being discharged to a level where it is no longer functional for providing sufficient power for starting the vehicle, or indeed, for powering the car alarm in the armed state.

There is therefore a need for alarm apparatus for a vehicle for determining if the vehicle is moved, and for giving an indication of the movement of the vehicle which allows the vehicle to be tracked and recovered.

The present invention is directed towards providing

such alarm apparatus, and the invention is also directed towards a method for determining if a vehicle is moved.

According to the invention there is provided alarm apparatus for a vehicle for determining if the vehicle is moved, the apparatus being operable in an armed state and a disarmed state and comprising

a global position sensing circuit for communicating with a global satellite positioning network for determining the location of the vehicle,

a control means for controlling the global position sensing circuit and for reading the state of the apparatus and for reading the global position sensing circuit at first predetermined time intervals when the apparatus is in the armed state for determining the position of the vehicle, the control means comprising

a first storing means for storing the first read position each time the apparatus is operated in the armed state,

a first comparing means for comparing the current position read from the global position sensing circuit with the first read position and for determining the difference between the current position and the first read position,

a second comparing means for comparing the

difference determined by the first comparing means with a predetermined difference value,

an interface means operating under the control of the control means for interfacing the apparatus with a transmission means, the interface means being responsive to the second comparing means determining that the difference determined by the first comparing means exceeds the predetermined difference value for outputting a first signal to the transmission means for transmission to a central monitoring station for indicating that the vehicle has been moved, and

a means for operating the apparatus in a low power mode during each first predetermined time interval.

In one embodiment of the invention the means for operating the apparatus in the low power mode is responsive to the second comparing means determining that the difference determined by the first comparing means does not exceed the predetermined difference value.

In another embodiment of the invention the means for operating the apparatus in the low power mode is responsive to the apparatus being in the armed state.

Preferably, the control means commences timing each first predetermined time interval after the second

comparing means determines that the difference determined by the first comparing means does not exceed the predetermined difference value or when the first signal has been transmitted by the transmission means.

Advantageously, the interface means comprises an interface circuit for interfacing the apparatus with a mobile telephone. Preferably, the interface circuit comprises a means for dialling a predetermined number on the mobile telephone.

Alternatively, or in addition, the interface means comprises an interface circuit for interfacing the apparatus with a radio transmitter. Preferably, the interface circuit comprises a means for activating the radio transmitter to transmit the first signal.

In one embodiment of the invention the control means comprises a second storing means for storing parameters of boundaries of a predetermined area within which the vehicle can validly move.

In another embodiment of the invention the control means reads the output of the global position sensing circuit at second predetermined time intervals when the apparatus is in the disarmed state for determining the position of the vehicle, and the control means

comprises a third comparing means for comparing the current position of the vehicle with the predetermined area for determining if the vehicle is outside the predetermined area.

In a further embodiment of the invention the interface means is responsive to the third comparing means for outputting a second signal to the transmission means for transmission to the central monitoring station for indicating that the vehicle has moved outside the predetermined area.

In a further embodiment of the invention the means for operating the apparatus in the low power mode is responsive to the third comparing means determining that the current read position of the vehicle is within the predetermined area for operating the apparatus in the low power mode during the next second predetermined time interval.

In a still further embodiment of the invention the means for operating the apparatus in the low power mode during each second predetermined time interval is responsive to the apparatus being in the disarmed state.

In one embodiment of the invention the control means

times each second predetermined time interval after the third comparing means determines that the current position of the vehicle is within the predetermined area, or after the second signal has been transmitted by the transmission means.

Preferably, the second signal comprises a message for indicating that the vehicle has moved outside the predetermined area and the current position of the vehicle.

Advantageously, the first signal comprises a message indicating that the vehicle has been moved and the current position of the vehicle.

In one embodiment of the invention the apparatus further comprises a vehicle monitoring circuit, the monitoring circuit being responsive to the apparatus being in the armed state for monitoring for unauthorised entry to the vehicle, and the apparatus may comprises a vehicle immobilising means, the immobilising means being responsive to the apparatus being in the armed state for immobilising the vehicle.

Further, the apparatus may comprises an alarm activating circuit for powering an alarm, the alarm activating circuit being responsive to the vehicle

monitoring circuit detecting unauthorised entry to the vehicle. Preferably, the alarm activating circuit is responsive to the second comparing means determining that the difference determined by the first comparing means exceeds the predetermined difference value.

In one embodiment of the invention the apparatus comprises a receiving means for receiving signals for operating the apparatus in the respective armed and disarmed states.

In another embodiment of the invention the apparatus comprises an entry means for entering the predetermined difference value into the first storing means. Preferably, the entry means facilitates entry of the value of the first predetermined time interval into the control means. Advantageously, the entry means facilitates entry of the parameters of the boundaries of the predetermined area into the second storing means. Ideally, the entry means facilitates entry of the value of the second predetermined time interval.

In one embodiment of the invention the apparatus comprises a timing means for timing each predetermined time interval.

Additionally, the invention provides a method for

determining if a vehicle is moved wherein the vehicle comprises alarm apparatus operable in an armed and a disarmed state and comprising a global position sensing circuit for communicating with a global satellite positioning network for determining the location of the vehicle, the method comprising the steps of

reading an output of the global position sensing circuit at first predetermined time intervals when the apparatus is in the armed state for determining the position of the vehicle,

storing the first read position each time after the apparatus is operated in the armed state in a first storing means,

comparing the current position read from the global position sensing circuit with the first read position in a first comparing means, and determining the difference between the current position and the first read position,

comparing the difference determined by the first comparing means in a second comparing means with a predetermined difference value,

outputting a first signal to a transmission means for transmission of the first signal to a central monitoring station for indicating that the vehicle has been moved if the difference determined by the first comparing means exceeds the predetermined difference value, and

operating the apparatus in a low power mode during each first predetermined time interval.

In one embodiment of the invention the alarm apparatus is operated in the low power mode after the second comparing means determines that the difference determined by the first comparing means does not exceed the predetermined difference.

In another embodiment of the invention the alarm apparatus is operated in the low power mode during the first predetermined time intervals when the apparatus is in the armed state.

In a further embodiment of the invention the method further comprises the step of comparing at second predetermined time intervals in a third comparing means the current position of the vehicle with parameters of boundaries of a predetermined area stored in a second storing means within which the vehicle can validly move for determining if the vehicle is outside the predetermined area when the apparatus is in the disarmed state. Preferably, the method further comprises the step of outputting a second signal for transmission to a central monitoring station for indicating that the vehicle has moved outside the predetermined area in response to the third comparing

means.

Advantageously, the alarm apparatus is operated in the low power mode during each second predetermined time interval after the third comparing means has determined that the current position of the vehicle is within the predetermined area.

In one embodiment of the invention the alarm apparatus is operated in the low power mode during each second predetermined time interval when the apparatus is disarmed.

Ideally, the timing of the second predetermined time intervals commences after the third comparing means determines that the current position of the vehicle is within the predetermined area, or after the second signal has been transmitted from the transmission means.

Preferably, the timing of each first predetermined time interval commences when the second comparing means determines that the difference determined by the first comparing means does not exceed the predetermined difference value, or when the first signal has been transmitted from the transmission means.

In one embodiment of the invention the second predetermined time interval lies in the range of thirty seconds to fifteen minutes. Preferably, the second predetermined time interval lies in the range of forty-five seconds to five minutes.

Advantageously, the second predetermined time interval is in the order of sixty seconds.

In one embodiment of the invention the first predetermined time interval lies in the range of five minutes to twenty minutes. Preferably, the first predetermined time interval lies in the range of eight minutes to fifteen minutes.

Advantageously, the first predetermined time interval is in the order of ten minutes.

Ideally, the predetermined difference value is stored in a look-up table. Preferably, the predetermined difference value is entered during set-up of the apparatus.

Advantageously, the predetermined difference value is a function of the allowable error in the global satellite position network.

Advantageously, each predetermined time interval is stored in a look-up table.

In one embodiment of the invention each predetermined time interval is entered during set-up of the apparatus.

In one embodiment of the invention an alarm circuit in the apparatus is activated for powering an alarm when the second comparing means determines that the difference determined by the first comparing means exceeds the predetermined difference value. Preferably, the alarm circuit is activated for powering an alarm when the third comparing means determines that the current position of the vehicle is outside the predetermined area.

The invention will be more clearly understood from the following description of a preferred embodiment thereof which is given by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a block representation of alarm apparatus according to the invention for use in a motor vehicle for determining if the vehicle is moved,

Figs. 2(a) and (b) illustrate a flow chart of a routine of a computer programme for controlling the alarm apparatus for Fig. 1, and

Figs. 3(a) and (b) illustrate a flow chart of another routine of the computer programme for controlling the alarm apparatus of Fig. 1.

Referring to the drawings there is illustrated an alarm apparatus according to the invention indicated generally by the reference 1 for determining if a motor vehicle is moved, and for transmitting an alert signal in the event of unauthorised movement of the vehicle. The apparatus 1 is operable in an armed state and in a disarmed state. In the armed state the apparatus 1 monitors the position of the vehicle for determining if the vehicle is moved and also monitors the vehicle for determining unauthorised entry to the vehicle. In the disarmed state the apparatus 1 monitors the position of the vehicle for determining if the vehicle is within a predetermined area. These aspects of the apparatus are described below.

The apparatus 1 comprises a typical car alarm circuit 2 which comprises a monitoring circuit 3 for monitoring ultrasonic transducers 4 located in the vehicle for monitoring for unauthorised entry into the vehicle,

when the apparatus 1 is in the armed state. The monitoring circuit 3 also monitors an electric current meter 5 when the apparatus 1 is in the armed state for monitoring current drawn from the vehicle battery also for determining unauthorised entry into the vehicle, in the event in an increase in current being drawn from the battery as a result of a courtesy switch being operated by opening of a door of the vehicle.

A control means comprising a control circuit 6 having a microprocessor 7 reads the monitoring circuit 3, and in the event of the monitoring circuit 3 determining unauthorised entry an alarm circuit 8 of the car alarm circuit 2 is activated for powering an audible alarm (not shown) for alerting to the unauthorised entry. A vehicle immobilising circuit 9 of the car alarm circuit 2 is also operated under the control of the control circuit 6 for immobilising the vehicle when the apparatus 1 is in the armed state. A receiving means, namely, a radio receiver 10 receives an appropriate radio signal which is relayed to the control circuit 6 for altering the state of the apparatus 1. If the apparatus 1 is in the disarmed state, the signal received by the radio receiver 10 causes the control circuit 6 to operate the apparatus 1 in the armed state, and vice versa. The car alarm circuit 2 and its operation will be well known to those skilled in the

art.

A global position sensing circuit 12 operates under the control of the control circuit 6 for determining the position of the motor vehicle using a global satellite positioning network. Such global position sensing circuits 12 will be well known to those skilled in the art. Briefly, by using a system of telemetry and receiving signals from three satellites of the global satellite positioning network, the global position sensing circuit can determine the precise location of the vehicle within a relatively narrow margin of error. In cases where global position sensing (GPS)is used the location of the vehicle can typically be determined within seventy-five metres of its exact location, while in the case of differential global position sensing (DGPS) the location can be determined with an accuracy of approximately ninety-five percent, which typically permits the location of the vehicle to be determined to within approximately two metres of its exact location. The control circuit 6 operates the global position sensing circuit 12 at first predetermined time intervals of approximately ten minutes duration when the apparatus 1 is in the armed state for determining the current position of the vehicle. The current position is read from an output of the global satellite position sensing circuit 12 by the control circuit 6.

When the apparatus 1 is in the disarmed state the control circuit 6 operates the global position sensing circuit 12 at second predetermined time intervals of approximately one minute duration for determining the position of the vehicle, which is also read by the control circuit 6 from the output of the circuit 12. An interface circuit 14 interfaces the alarm apparatus 1 with a mobile telephone 15, and under the control of the control circuit 6 outputs first and second signals through the mobile telephone 15 to a central monitoring station for indicating if the vehicle 1 has been moved, or if the vehicle has moved outside the boundaries of the predetermined area. This is described in more detail below.

Before describing the alarm apparatus 1 in further detail, an outline of the operation of the alarm apparatus 1 will first be given. When the alarm apparatus 1 is in the disarmed state, and the radio receiver 10 receives the appropriate signal for arming the apparatus 1, the control circuit 6 operates the apparatus 1 in the armed state. In this state the control circuit 6 operates the immobilising circuit 9 for immobilising the vehicle, and activates the monitoring circuit 3 for monitoring the ultrasonic sensors 4 and the electrical current meter 5. Initially on being armed, the control circuit 6

operates the global position sensing circuit 12 for determining the location of the vehicle, and the control circuit 6 reads the position of the vehicle from the output of the global position sensing circuit 12. This, typically, is given by the longitude and latitude coordinates of the position of the vehicle. This first read position is stored in a first storing means, namely, a first random access memory 16 within the control circuit 6, and the control circuit 6 operates the alarm apparatus 1 in a low power mode for the first predetermined time interval for minimising the power requirement from the vehicle battery. During this and subsequent first predetermined time intervals, the monitoring circuit 3 periodically monitors the ultrasonic sensors 4 and the electric meter 5 at intervals typically of fifteen seconds.

After the first predetermined time interval has timed out the control circuit 6 wakes up the alarm apparatus 1, and operates the global position sensing circuit 12 for determining the current position of the vehicle. This is read from the output of the global position sensing circuit 12 by the control circuit 6. A first comparing means, namely, a first comparator 17 in the control circuit 6 compares the current position of the vehicle with the first read position in the first storing means 16 and determines the difference between

the two positions. This difference value is fed to a second comparing means, namely, a second comparator 18 in the control circuit 6 which compares the difference determined by the first comparator 17 with a predetermined difference value which is stored in a look-up table in a second storing means, namely, a general random access memory 19 of the control circuit 6. If the second comparator 18 determines that the difference determined by the first comparator 17 does not exceed the predetermined difference value, then the control circuit 6 returns the alarm apparatus 1 to operate in the low power mode for another first predetermined time interval of approximately ten minutes, at the end of which the control circuit 6 again wakes up the alarm apparatus 1 for determining the next current position of the vehicle as already described.

If the second comparator 18 determines that the difference determined by the first comparator 17 exceeds the predetermined difference value, in other words, indicating that the vehicle has been moved, the control circuit 6 activates the alarm circuit 8 for powering the alarm (not shown). The control circuit 6 operates the interface circuit 14 for powering the mobile telephone 15 to cause the mobile telephone 15 to dial the central monitoring station, and when a line

has been established with the central monitoring station the first signal is relayed by the mobile telephone 15. In this embodiment of the invention the first signal contains a message which indicates that the vehicle has been moved and gives the current position of the vehicle by longitude and latitude coordinates.

After the first signal has been relayed through the mobile telephone 15 and an acknowledgement signal has been received and read by the control circuit 6, the control circuit 6 may again operate the apparatus 1 in the low power mode for another first predetermined time interval of approximately ten minutes, and so the alarm apparatus 1 continues to operate for so long as the alarm apparatus 1 is in the armed state. In other words, during the period while the alarm circuit 1 is in the armed state, the control circuit 6 wakes up the global position sensing circuit 12, and reads the current position of the vehicle from the global position sensing circuit 12 at the first predetermined time intervals of ten minutes.

When the radio receiver 10 receives an appropriate signal for disarming the alarm apparatus 1, the control circuit 6 disarms the alarm apparatus 1 and operates the alarm apparatus 1 in the disarmed state. In the

disarmed state, the vehicle immobilising circuit 9 is deactivated, thereby mobilising the vehicle 1, and the monitoring circuit 3 is deactivated. While the alarm apparatus 1 is in the disarmed state the control circuit 6 operates the global position sensing circuit 12 at the second predetermined time intervals of one minute duration, and reads the current position of the vehicle from the output of the global position sensing circuit 12. The current position of the vehicle is compared in a third comparing means, namely, a third comparator 20, with a predetermined area which is stored in the general random access memory 19 in the form of boundary coordinates to ascertain if the current position of the vehicle is outside the predetermined area. If it is determined that the current position of the vehicle is within the predetermined area, then the control circuit 6 operates the alarm apparatus for another second predetermined time interval of approximately one minute in the low power mode. At the end of that second predetermined time interval, the control circuit 6 wakes up the alarm apparatus 1 and again reads the current position of the vehicle.

In the event that the third comparator 20 determines that the current position of the vehicle is outside the predetermined area, the control circuit 6 operates the

alarm circuit 8 for powering the alarm (not shown). This alerts the driver to the fact that the vehicle has been moved outside the predetermined area. The control circuit 6 also operates the interface circuit 14 for powering the mobile telephone 15 for relaying the second signal to the central monitoring station. The second signal contains a message indicating that the vehicle has moved outside the predetermined area and contains the longitude and latitude coordinates of the current position of the vehicle. After an acknowledgement signal has been received by the control circuit 6 through the mobile telephone 15 the control circuit 6 may again operate the alarm apparatus 1 in the low power mode for the next second predetermined time interval of one minute, at the end of which the control circuit 6 operates the global position sensing circuit 12 for determining the current position of the vehicle and the control circuit 6 reads the current position which again is compared by the third comparator 20 with the predetermined area stored in the general random access memory 19.

An entry means, namely, an input port 22 is provided in the control circuit 6 to the microprocessor 7 for connecting to a suitable inputting apparatus, for example, a personal computer for inputting the value of the predetermined difference for comparison with the

difference between the first read position and the current position of the vehicle when the apparatus is in the armed state. The boundary coordinates of the predetermined area are also inputted through the input port 22, as are the values of the first predetermined time interval and the second predetermined time interval, and other operating parameters and codes which are required for normal operation of the alarm apparatus 1. These will be well known to those skilled in the art. Typically, the parameters and codes are entered through the input port 22 during set-up of the alarm apparatus 1, and may be either factory entered or entered by an installer of the apparatus in a vehicle.

Turning now to Figs. 2 and 3, routines of a computer programme which are stored in the microprocessor 7 for operating the apparatus 1 will now be described. The routine, the flow chart of which is illustrated in Figs. 2(a) and (b) controls the apparatus 1 when the apparatus 1 is in the armed state for determining if the vehicle is moved while in the armed state. The routine, the flow chart of which is illustrated in Figs. 3(a) and (b) controls the apparatus 1 when the apparatus 1 is in the disarmed state for determining if the vehicle moves outside the predetermined area.

Referring initially to Figs. 2(a) and (b), block 40

starts the routine of Fig. 2, and the routine moves to block 41 which determines if the apparatus 1 is in the armed state. If the apparatus 1 is not in the armed state, the routine moves to block 42 which returns control of the apparatus 1 to the calling programme. On block 41 determining that the apparatus 1 is in the armed state, the routine moves to block 44. Block 44 calls up a check position routine stored in the microprocessor 1 for operating the global position sensing circuit 12 for determining the current position of the vehicle. Such routines will be well known to those skilled in the art, and the actual operation of the global position sensing circuit 12 for determining the location of the vehicle using a global satellite positioning network will also be well known to those skilled in the art, and further description should not be required. The routine then moves to block 45 which waits for a valid position being determined by the global position sensing circuit 12, and on a valid position appearing on the output of the global position sensing circuit 12, the microprocessor 7 reads the current position of the vehicle and moves to block 46. Block 46 stores the current position as the first read position of the vehicle.

The routine then moves to block 47 which reads from a look-up table stored in the general random access

memory 19 the first predetermined time interval which is to elapse between each time the check position routine is called up. In other words, the time interval between the respective times that the current position of the vehicle is read from the global position sensing circuit 12. The routine then moves to block 48 which sets a timer (not shown) in the microprocessor 7 to time the first predetermined time interval of ten minutes duration. The routine then moves to block 49, and in turn, to block 50, which respectively power down the global position sensing circuit 12, the mobile telephone 15 and the interface circuit 14. The routine then moves to block 51 which operates the control circuit 6 and in turn the remainder of the apparatus 1 into the low power mode. The routine then cycles in block 52 checking the elapsed time since the timer was set by block 48. When block 52 determines that the elapsed time is equal to the first predetermined time interval, the routine moves to block 53 which wakes up the control circuit 3, and in turn, the apparatus 1.

The routine then moves to block 55 which calls up the check position routine which in turn activates the global position sensing circuit 12 for determining the new current position of the vehicle and moves to block 56. Block 56 waits for the new valid current position

and reads the new current position from the global position sensing circuit 12. The routine then moves to block 57 which determines by using the first comparator 17 the difference in the just read current position and the stored first read position, and moves to block 58. Block 58 stores the difference determined by the first comparator 17 in the general random access memory 19. The routine then moves to block 59 which reads the predetermined difference from the general random access memory 19, and the routine moves to block 60. Block 60 compares the difference determined by the first comparator 17 with the predetermined difference. If the second comparator 18 determines that the difference determined by the first comparator 17 does not exceed the predetermined difference the routine moves to block 61 which checks if the alarm apparatus 1 is still in the armed state. If so, block 61 returns the routine to block 47. If block 61 determines that the alarm apparatus 1 is no longer in the armed state, the routine moves to block 52 which returns control of the microprocessor 7 to the calling programme.

Should block 60 determine that the difference determined by the first comparator 17 is greater than the predetermined difference, the routine moves to block 64 which activates the alarm circuit 8 for powering the alarm (not shown). The routine then moves

to block 65 which activates the interface circuit 14 for powering up the mobile telephone 15 and dialling the central monitoring station. The routine then moves to block 66 and waits for an appropriate time for a line to be established between the mobile telephone 15 and the central monitoring station, and in turn moves to block 67 to check if a line has been established with the central monitoring station. If block 67 determines that a line has been established the routine moves to block 68 which outputs the first signal to the mobile telephone 15 for relaying to the central monitoring station. The routine then moves to block 69 which waits for an appropriate time for an acknowledgement from the central monitoring station, and in turn moves to block 70 which checks if an acknowledgement has been received. If an acknowledgement has not been received the routine is returned to block 65. If an acknowledgement is received, the routine is moved to block 71 which returns control of the microprocessor 7 to the calling programme. At that state, the calling programme may call up the routine of Fig. 2 again, under the control of the central monitoring station by a command received through the mobile telephone 15 and the interface circuit 14. In which case, the routine would be entered at block 47. This permits the central monitoring station to determine if the vehicle is still

being moved, and also the current position of the vehicle at the respective first predetermined time intervals for facilitating location of the vehicle.

In the event that block 67 determines that a line has not been established the routine is returned to block 65.

The value of the predetermined difference stored in the general random access memory 19 is a function of the allowable error in the global satellite positioning network, this is to avoid false alarms. The predetermined difference will depend on the particular global satellite positioning network being used. In the case of GPS the predetermined difference will typically be set at seventy-five metres, and in the case of DGPS the predetermined difference will typically be set at two metres.

Turning now to Figs. 3(a) and (b), the routine for determining if the vehicle moves outside the predetermined area will now be described. Block 80 starts the routine which then moves to block 81 which checks if the alarm apparatus 1 is in the armed state, and if so, the routine moves to block 82 which returns control of the microprocessor 7 to the calling programme. Should block 81 determine that the alarm

apparatus 1 is disarmed, the routine moves to block 83 which calls up the check position routine which has already been briefly described with reference to Fig. 2. The routine then moves to block 84 which waits for a valid current position appearing on the output of the global position sensing circuit 12, and then reads the current position. The routine then moves to block 85 which stores the current position read by block 84 and moves the routine to block 86. Block 86 reads the boundary coordinates of the predetermined areas stored in the general random access memory 19, and the routine moves to block 87. Block 87 checks by the third comparator 20 if the current position read by block 84 is within the predetermined area. If block 87 determines that the current position is within the predetermined area, the routine moves to block 88.

Block 88 checks if the alarm apparatus is armed, and if so, the routine moves to block 89 which returns control of the microprocessor 7 to the calling programme. Should block 88 determine that the alarm apparatus is not armed, in other words, disarmed, the routine moves to block 90 which reads the second predetermined time interval from the general random access memory 19 and moves to block 91. Block 91 sets the timer to time the second predetermined time interval, and the routine moves to block 92 which operates the alarm apparatus 1

in the low power mode for the duration of the second predetermined time interval. The routine then cycles in block 93 until the elapsed time from the time the timer is set by block 91 is equal to the second predetermined time interval, and then the routine is returned to block 81 which again checks if the vehicle is armed, and repeats the routine.

Should block 87 determine that the current position is outside the predetermined area the routine moves to block 95 which activates the alarm circuit for powering the alarm (not shown) to indicate to the driver that the vehicle has been moved outside the predetermined area. The routine then moves to block 96 which activates the interface circuit for powering up the mobile telephone 15 to establish a line with the central monitoring station. The routine then moves to block 97 to wait for a line to be established. After the wait period the routine moves to block 98 which checks if a line has been established. If a line has not been established, the routine returns to block 96. On block 98 determining that a line has been established, the routine moves to block 99 which outputs the second signal for relaying to the central monitoring station by the mobile telephone 15. The routine then moves to block 100 which waits for a waiting period for an acknowledgement from the central

monitoring station. After the waiting period the routine moves to block 101 which checks if an acknowledgement has been received, and if an acknowledgement has not been received the routine returns to block 96. If block 101 determines that an acknowledgement has been received, the routine is moved to block 88, which has already been described.

Turning now to the first and second signals which are outputted by the control circuit 6, as discussed the first signal contains a message indicating that the vehicle has been moved while the apparatus is in the armed state, and also contains the coordinates of the current position of the vehicle. The second signal contains a message indicating that the vehicle has been moved outside the predetermined area, and also contains the coordinates of the current position of the vehicle. The first and second signals may be in analog or digital form, and may be suitable for receipt by a computer for subsequent display, so that the message and coordinates of the current position of the vehicle may be displayed on a monitor of a computer, for example, a personal computer, or alternatively, may be printed out under the control of a computer at the central monitoring station. Alternatively, the signals may be in a form which is suitable for activating a voice synthesizer at the central monitoring station for

speaking the message and the coordinates of the current position of the vehicle.

In use, with the alarm apparatus 1 installed in a vehicle, and set-up, on the alarm apparatus 1 receiving an appropriate radio signal through the radio receiver 10 the state of the alarm apparatus 1 is changed from its current state. Thus, on receipt of the appropriate radio signal if the alarm apparatus has been in the disarmed state, the alarm apparatus is operated under the control of the control circuit 6 in the armed state, and vice versa. The control circuit 3 operates under the routine of Figs. 2(a) and 2(b) when the alarm apparatus 1 is operated in the armed state, and under the routine of Figs. 3(a) and (b) when the alarm apparatus is in the disarmed state. The routines of Figs. 2 and 3 are called up under the control of a main calling programme which generally controls the control circuit 6. Accordingly, should the alarm circuit 1 be operating in the armed state, and an attempt is made to move the vehicle, for example, by pushing the vehicle, on the alarm apparatus determining that the difference between the current position of the vehicle and the first read position of the vehicle exceeds the predetermined difference, the first alarm signal is outputted to the central monitoring station. The central monitoring station may then take appropriate

action. Needless to say, while the apparatus 1 is in the armed state, if an attempt is made to break into the vehicle, this is determined by the monitoring-circuit 3, and the alarm circuit is operated for powering up the vehicle alarm. Additionally, the control circuit 6 may also activate the interface circuit 14 for relaying a third signal to the central monitoring station, which would contain a message indicating that the vehicle had been broken into and would also give the location of the vehicle by the latitude and longitude coordinates of the position of the vehicle.

While the alarm apparatus 1 is in the disarmed state, the routine of Fig. 3 monitors the position of the vehicle at the second predetermined time intervals. In the event of the vehicle moving outside the predetermined area the second signal is outputted to the central monitoring station.

It will of course be appreciated that while the boundary coordinates of the predetermined area have been described as being entered in the general random access memory 19, during set-up of the apparatus, it will be readily apparent that the predetermined area may be altered at any stage by an authorised person by merely changing the coordinates which define the

boundaries of a new predetermined area. This, may be carried out by connecting the input port 22 to a suitable computer, or indeed, may be altered by downloading the new boundary coordinates through the mobile telephone 15 under the control of the central monitoring station.

The advantages of the apparatus according to the invention are many, a particularly important advantage of the apparatus is achieved by virtue of the fact that should an attempt be made to move the vehicle to a remote location prior to breaking into the vehicle where the alarm would not be heard, the alarm apparatus outputs a signal to a central monitoring station once the alarm apparatus determines that the vehicle has been moved. Such moving could, for example, be carried out by a thief pushing the vehicle without entering the vehicle, or alternatively, by loading the vehicle onto a transporter, or indeed by towing the vehicle.

Another important advantage of the apparatus according to the invention is achieved when the alarm apparatus is suitable for determining if the vehicle has been moved outside a predetermined area. This feature of the invention is particularly suitable for owners of car fleets for hire or the like, for monitoring the position of the vehicle to determine if the vehicle is

moved outside a predetermined area, for example, is moved across a boarder from one country to another in an attempt to steal the vehicle or the like.

Another important advantage of the apparatus according to the invention is that the power requirement from the vehicle battery is minimised due to the fact that the apparatus operates in a low power mode for first and second predetermined time intervals, and in particular, for first predetermined time intervals when the vehicle is immobilised and the vehicle battery is not being charged.

While the apparatus according to the invention has been described for use in a motor vehicle, it will be readily apparent that the apparatus may be used in any other vehicle, for example, an aeroplane, a boat, motorcycle or the like. It will also be appreciated that it is not essential that the alarm apparatus should comprise an alarm circuit.

While the first predetermined time interval has been described as being ten minutes duration, it will be readily apparent to those skilled in the art that the first predetermined time interval may be of any desired duration, and may be factory set or set by the owner of the vehicle, or in the case of the vehicle being owned

by a fleet hire company, by the fleet owner or an authorised person. However, it is believed that to optimise between minimising the power requirement from the vehicle battery, and the need to effectively monitor the vehicle, a first predetermined time interval of the order of ten minutes is desirable, although, it is believed that a first predetermined time interval in the range of five minutes to fifteen minutes would be acceptable.

Similarly, the second predetermined time interval while it has been described as being of one minute duration, may be of any other desired duration, and typically, may lie in the range from thirty seconds to fifteen minutes, and indeed the second predetermined time interval may be even longer or shorter as could the first predetermined time interval.

CLAIMS

1. Alarm apparatus for a vehicle for determining if the vehicle is moved, the apparatus being operable in an armed state and a disarmed state and comprising

a global position sensing circuit for communicating with a global satellite positioning network for determining the location of the vehicle,

a control means for controlling the global position sensing circuit and for reading the state of the apparatus and for reading the global position sensing circuit at first predetermined time intervals when the apparatus is in the armed state for determining the position of the vehicle, the control means comprising

a first storing means for storing the first read position each time the apparatus is operated in the armed state,

a first comparing means for comparing the current position read from the global position sensing circuit with the first read position and for determining the difference between the current position and the first read position,

a second comparing means for comparing the difference determined by the first comparing means with a predetermined difference value,

an interface means operating under the control of the control means for interfacing the apparatus with a

transmission means, the interface means being responsive to the second comparing means determining that the difference determined by the first comparing means exceeds the predetermined difference value for outputting a first signal to the transmission means for transmission to a central monitoring station for indicating that the vehicle has been moved, and

a means for operating the apparatus in a low power mode during each first predetermined time interval.

2. Alarm apparatus as claimed in Claim 1 in which the means for operating the apparatus in the low power mode is responsive to the second comparing means determining that the difference determined by the first comparing means does not exceed the predetermined difference value.

3. Alarm apparatus as claimed in Claim 1 or 2 in which the means for operating the apparatus in the low power mode is responsive to the apparatus being in the armed state.

4. Alarm apparatus as claimed in any preceding claim in which the control means commences timing each first predetermined time interval after the second comparing means determines that the difference determined by the first comparing means does not exceed the predetermined

difference value or when the first signal has been transmitted by the transmission means.

5. Alarm apparatus as claimed in any preceding claim in which the interface means comprises an interface circuit for interfacing the apparatus with a mobile telephone.

6. Alarm apparatus as claimed in Claim 5 in which the interface circuit comprises a means for dialling a predetermined number on the mobile telephone.

7. Alarm apparatus as claimed in any preceding claim in which the interface means comprises an interface circuit for interfacing the apparatus with a radio transmitter.

8. Alarm apparatus as claimed in Claim 7 in which the interface circuit comprises a means for activating the radio transmitter to transmit the first signal.

9. Alarm apparatus as claimed in any preceding claim in which the control means comprises a second storing means for storing parameters of boundaries of a predetermined area within which the vehicle can validly move.

10. Alarm apparatus as claimed in Claim 9 in which the control means reads the output of the global position sensing circuit at second predetermined time intervals when the apparatus is in the disarmed state for determining the position of the vehicle, and the control means comprises a third comparing means for comparing the current position of the vehicle with the predetermined area for determining if the vehicle is outside the predetermined area.

11. Alarm apparatus as claimed in Claim 10 in which the interface means is responsive to the third comparing means for outputting a second signal to the transmission means for transmission to the central monitoring station for indicating that the vehicle has moved outside the predetermined area.

12. Alarm apparatus as claimed in Claim 11 in which the means for operating the apparatus in the low power mode is responsive to the third comparing means determining that the current read position of the vehicle is within the predetermined area for operating the apparatus in the low power mode during the next second predetermined time interval.

13. Alarm apparatus as claimed in Claim 11 or 12 in which the means for operating the apparatus in the low

power mode during each second predetermined time interval is responsive to the apparatus being in the disarmed state.

14. Alarm apparatus as claimed in any of Claims 11 to 13 in which the control means times each second predetermined time interval after the third comparing means determines that the current position of the vehicle is within the predetermined area, or after the second signal has been transmitted by the transmission means.

15. Alarm apparatus as claimed in any of Claims 11 to 14 in which the second signal comprises a message for indicating that the vehicle has moved outside the predetermined area and the current position of the vehicle.

16. Alarm apparatus as claimed in any preceding claim in which the first signal comprises a message indicating that the vehicle has been moved and the current position of the vehicle.

17. Alarm apparatus as claimed in any preceding claim in which the apparatus further comprises a vehicle monitoring circuit, the monitoring circuit being responsive to the apparatus being in the armed state

for monitoring for unauthorised entry to the vehicle.

18. Alarm apparatus as claimed in Claim 17 in which the apparatus comprises a vehicle immobilising means, the immobilising means being responsive to the apparatus being in the armed state for immobilising the vehicle.

19. Alarm apparatus as claimed in Claim 17 or 18 in which the apparatus comprises an alarm activating circuit for powering an alarm, the alarm activating circuit being responsive to the vehicle monitoring circuit detecting unauthorised entry to the vehicle.

20. Alarm apparatus as claimed in any preceding claim in which the alarm activating circuit is responsive to the second comparing means determining that the difference determined by the first comparing means exceeds the predetermined difference value.

21. Alarm apparatus as claimed in any preceding claim in which the apparatus comprises a receiving means for receiving signals for operating the apparatus in the respective armed and disarmed states.

22. Alarm apparatus as claimed in any preceding claim in which the apparatus comprises an entry means for

entering the predetermined difference value into the first storing means.

23. Alarm apparatus as claimed in Claim 22 in which the entry means facilitates entry of the value of the first predetermined time interval into the control means.

24. Alarm apparatus as claimed in Claim 22 or 23 in which the entry means facilitates entry of the parameters of the boundaries of the predetermined area into the second storing means.

25. Alarm apparatus as claimed in any of Claims 22 to 23 in which the entry means facilitates entry of the value of the second predetermined time interval.

26. Alarm apparatus as claimed in any preceding claim in which the apparatus comprises a timing means for timing each predetermined time interval.

27. Alarm apparatus for a vehicle for determining if a vehicle is moved, the alarm apparatus being substantially as described herein with reference to and as illustrated in the accompanying drawings.

28. A method for determining if a vehicle is moved

wherein the vehicle comprises alarm apparatus operable in an armed and a disarmed state and comprising a global position sensing circuit for communicating with a global satellite positioning network for determining the location of the vehicle, the method comprising the steps of

reading an output of the global position sensing circuit at first predetermined time intervals when the apparatus is in the armed state for determining the position of the vehicle,

storing the first read position each time after the apparatus is operated in the armed state in a first storing means,

comparing the current position read from the global position sensing circuit with the first read position in a first comparing means, and determining the difference between the current position and the first read position,

comparing the difference determined by the first comparing means in a second comparing means with a predetermined difference value,

outputting a first signal to a transmission means for transmission of the first signal to a central monitoring station for indicating that the vehicle has been moved if the difference determined by the first comparing means exceeds the predetermined difference value, and

operating the apparatus in a low power mode during each first predetermined time interval.

29. A method as claimed in Claim 28 in which the alarm apparatus is operated in the low power mode after the second comparing means determines that the difference determined by the first comparing means does not exceed the predetermined difference.

30. A method as claimed in Claim 28 or 29 in which the alarm apparatus is operated in the low power mode during the first predetermined time intervals when the apparatus is in the armed state.

31. A method as claimed in any of Claims 28 to 30 in which the method further comprises the step of comparing at second predetermined time intervals in a third comparing means the current position of the vehicle with parameters of boundaries of a predetermined area stored in a second storing means within which the vehicle can validly move for determining if the vehicle is outside the predetermined area when the apparatus is in the disarmed state.

32. A method as claimed in Claim 31 in which the method further comprises the step of outputting a second signal for transmission to a central monitoring

station for indicating that the vehicle has moved outside the predetermined area in response to the third comparing means.

33. A method as claimed in Claim 31 or 32 in which the alarm apparatus is operated in the low power mode during each second predetermined time interval after the third comparing means has determined that the current position of the vehicle is within the predetermined area.

34. A method as claimed in any of Claims 31 to 33 in which the alarm apparatus is operated in the low power mode during each second predetermined time interval when the apparatus is disarmed.

35. A method as claimed in any of Claims 31 to 34 in which timing of the second predetermined time intervals commences after the third comparing means determines that the current position of the vehicle is within the predetermined area, or after the second signal has been transmitted from the transmission means.

36. A method as claimed in any of Claims 28 to 35 in which timing of each first predetermined time interval commences when the second comparing means determines that the difference determined by the first comparing

means does not exceed the predetermined difference value, or when the first signal has been transmitted from the transmission means.

37. A method as claimed in any of Claims 31 to 36 in which the second predetermined time interval lies in the range of thirty seconds to fifteen minutes.

38. A method as claimed in any of Claims 31 to 37 in which the second predetermined time interval lies in the range of forty-five seconds to five minutes.

39. A method as claimed in any of Claims 31 to 38 in which the second predetermined time interval is in the order of sixty seconds.

40. A method as claimed in any of Claims 28 to 39 in which the first predetermined time interval lies in the range of five minutes to twenty minutes.

41. A method as claimed in any of Claims 28 to 40 in which the first predetermined time interval lies in the range of eight minutes to fifteen minutes.

42. A method as claimed in any of Claims 28 to 41 in which the first predetermined time interval is in the order of ten minutes.

43. A method as claimed in any of Claims 28 to 42 in which the predetermined difference value is stored in a look-up table.

44. A method as claimed in any of Claims 28 to 43 in which the predetermined difference value is entered during set-up of the apparatus.

45. A method as claimed in any of Claims 28 to 44 in which the predetermined difference value is a function of the allowable error in the global satellite position network.

46. A method as claimed in any of Claims 28 to 45 in which the value of each predetermined time interval is stored in a look-up table.

47. A method as claimed in any of Claims 28 to 46 in which the value of each predetermined time interval is entered during set-up of the apparatus.

48. A method as claimed in any of Claims 28 to 47 in which an alarm circuit in the apparatus is activated for powering an alarm when the second comparing means determines that the difference determined by the first comparing means exceeds the predetermined difference value.

49. A method as claimed in Claim 48 when dependent on Claim 31 in which the alarm circuit is activated for powering an alarm when the third comparing means determines that the current position of the vehicle is outside the predetermined area.

50. A method for determining if a vehicle is moved, the method being substantially as described herein with reference to and as illustrated in the accompanying drawings.

The Patent Office

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Claims searched:	1-50	**Date of search:**	9 April 1998

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G4N (NHVX, NPL)

Int Cl (Ed.6): B60R 25/10

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,P	GB 2306736 A	(MOTOROLA)	1,28 at least
X,P	GB 2305285 A	(ROVER)	"
X	GB 2270405 A	(BARRON)	"
X	EP 0242099 A2	(ADVANCED)	"
X	US 4651157	(GRAY)	"

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